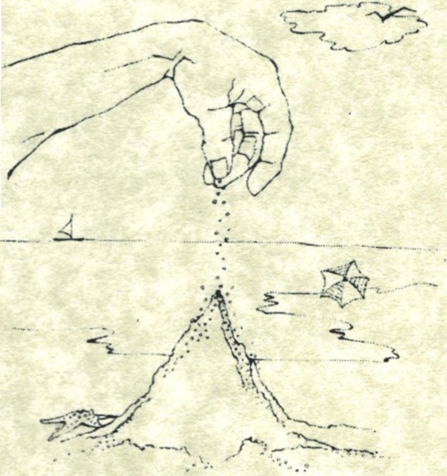
SAND

A Simple Solution to the Paradox of the Heap



Applying Bak et al 1987
& the Abelian Sandpile to
Eubulides of the 4th Cent.

When does a pile become a heap? To Eubulides of Miletus, this was a serious question. It's called the sorites paradox, after the greek word soros for heap.

But what if that's not a perfect translation? Maybe a Greek soros was a bit smaller than an English heap, since lacking heavy machinery they dealt in and imagined more modest mounds.

Silly, right? Asking like this seems to expose the question as a nonparadox, and require us to investigate the weakness of words.

So fuck Eubulides, right? His idle musings should be forgotten. Today we have real science. Big, hard science. The toughest and most powerful could be complexity science, which is the open door at chaos theory's dead end. While weaklings mewl about quantum, complexity science just sits there at a distance accumulating aura.

Since it touches everything, it has no home. You can't yet get a degree in complexity somewhere at a department of complexity. You have to start yourself at the foundational hypothesis.

Self-organized criticality. That's the idea, from Bak '87. He said it's how complexity arises, and the paper gave its **model:** the **sandpile.**

Wait a minute.

Bak was pushing grains of sand around to see what a pile acts like?

Eubulides was moving grains back and forth to find out what a heap looks like.

Is there a way we could put them together?

Why not? We've got no professor of complexity telling us not to.

First, promote Bak's piles to heaps. That's what he meant, and they can be as big as mountains: they model avalanching, in fact.

Avalanching behavior is actually what your **critical brain** has in common with the sandpile model.

What's it like? It's **scale-free.** That means there's no average size of avalanche. It means if you record that behavior, you know what it will look like on a graph: it'll take a certain shape of **power law.**

The power law distribution is that arc on a graph that goes up to infinity that has the same angle no matter how far you zoom in or up. On the other side of it is the **long-tail distribution.**

This distribution shows up everywhere in complex systems, often along with a pink noise and a fractal shape.

Here's what I suggest: we look for it.

We take a grain of sand. In a real-world, built physical model. We add sand incrementally. And we say the pile becomes a heap **when it starts acting like one.** Past a certain size, it will exhibit scale-free behaviors. Its activity will show power law distribution, beginning at mass X and reliably past mass Y.

And we've taken a thought experiment and turned it into a physical test. We just had to stop asking about the thing's essence, and start looking at its activity.

You're welcome, Eubulides.

Further Questions

-Should we expect our system's avalanching to happen with regularity, or at random?

-How about if we changed our incremental grain addition to a constant pour?

-Could such parameter tweaks lead to visual complexity markers' formation in the sand? (i.e. fractals)

-What would it sound like if we could hear it? (i.e. using "squeaky" or "singing" sand)

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